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Fielding specific walk/run patterns in English professional Cricket

Thomas Turner[1], Steve Cooper[1], Rob Davies[2], Chris Hardy[2], Carl Petersen[3*].
Corresponding Author[*]

[1]*Glamorgan County Cricket Club, Sports Science and Medicine Department, Wales*
[2]*Cardiff Metropolitan University, Cardiff School of Sport and Health Sciences, Wales*
[3]*University of Canterbury, School of Health Sciences, New Zealand*

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ABSTRACT

In cricket research, players are typically categorized by role. However, players of a certain role, for instance fast bowlers may not consistently field in the same position which leads to inaccurate representations of the physical demands of fielding. To identify fielding specific movement demands across three cricket formats (4 multi-day, 6 one day, 4 T20), 14 professional male cricketers had positional movements determined with 10 Hz Optimeye S5 (Catapult, Melbourne, Australia) global positioning system (GPS) units. Players observed fielding in 35 common cricket locations were described as either being in a stationary catching, 30m ring or boundary position. Data were totalled in movement velocities bands: Walking (<7 km/h), Jogging (7 - 15 km/h), Striding (15 - 20 km/h), High speed running (20 - 25 km/h), Sprinting (> 25 km/h), and further classified into low intensity running (walking and jogging) or high intensity running (HIR). The HIR running was significantly different for each fielding position within each game format. Boundary fielders covered the most HIR distance per hour (930 ± 1085 m/h) in One day compared to multi-day (889 ± 435 m/h) and Twenty20 (T20) (628 ± 438 m/h) formats. Similarly, 30m ring fielders also covered relatively greater distance in the One day format (594 ± 286 m/h) compared to multi-day and T20 formats (227 ± 345, 170 ± 165 m/h) respectively. The catching positions had similar hourly demands between Multi-day (370 ± 291 m/h) and One day (385 ± 342 m/h) formats. This study identifies that the boundary positions have the greatest HIR demands across all three cricket formats. When setting a field, captains should be mindful not only of position-specific skill requirements, but also of movement speed, fitness characteristics and within-session recovery needs of players. This information is able to better inform cricket's physical preparation coaches and tacticians.

1. Introduction

With the proliferation of microtechnology for sportspeople, cricket conditioning coaches are seeking detailed information on positional movement demands. Given that fielding is an essential component to winning matches, the lack of research in this area is disconcerting (MacDonald et al., 2013). To date, what little information there is has been largely reported by player role as opposed to fielding position. Yet, players in the same playing role could field in very different types of position and subsequently have very different movement demands. Additionally, game to game the same player may field in different types of fielding positions. In order to physically prepare their players, conditioning coaches need to know the normative data for the likely demands encountered by their players who are known to specialise in certain positions. Cricket has numerous possible fielding positions which creates logistical issues as to how these should be classified and reported in motion analysis studies.

In the last decade, several motion analysis studies have been conducted in cricket and its three main match formats. In real-time, Rudkin & O'Donoghue (2008) coded the movement of the cover-point fielder during the first 10 overs of play in each session of three multi-day cricket games. The extrapolated data revealed this fielding position required players to cover ~15500 m in a day, with high intensity activity representing 1.6% of match time. High intensity bursts were found to last ~1.3 seconds. Given, the considerable logistics of live-coding a single position and the time intensive extrapolation techniques required this data collection

[*]Corresponding Author: Carl Petersen, School of Health Sciences, University of Canterbury, New Zealand, carl.petersen@canterbury.ac.nz

method was quickly superseded by GPS technology. Improved miniaturisation, fast downloading and over time the reduced cost of GPS devices has resulted in most professional clubs investing in this technology.

Several studies have investigated the physical demands of cricket and the playing roles within the game using GPS. Petersen et al., (2009) found that in T20 fast bowlers covered a distance of 8489 ± 1493m (mean ± SD) during the fielding innings with 723 ± 186m consisting of "sprinting" (5+ $m.s^{-1}$ or 18 $km.h^{-1}$), whereas spin bowlers covered 8141 ± 1308m with 154 ± 144m of "sprinting". This study highlights the variation in "sprinting" demands between playing roles in T20 cricket, with fast bowlers completing significantly more meters "sprinting". When investigating fielding Petersen et al., (2009) found that fielders during Twenty20 Games covered a total distance of 8141 ± 1308m, including 154 ± 144m of "sprinting" (5+ $m.s^{-1}$). More recently, Sholto-Douglas et al., (2020) has reported fielders cover a total distance of 5900 ± 900m during Twenty20 innings ranging in length from 40 – 97 min. Petersen et al., (2010) also compared distance covered in metres/hour over the three formats of cricket for fielders, finding that Twenty20 was the most intense, followed by One-Day and then Multi-Day.

The major limitation with current research utilising GPS to identify cricket demands is that all studies are identifying workloads performed by a player's role within the game (bowler, fielder and wicketkeeper). In a cricket match, during the fielding innings, a player's role will not be the single factor when dictating the work performed. A high variation comes within the fielding activity itself, regardless of a players role. Geographically where players are positioned on the field, will have a strong influence on the work performed during that fielding innings. If the demands of various fielding positions were to be better understood then a much clearer representation of work performed can be identified for each individual. Obviously, actual specific role demands of bowling (fast versus spin bowlers) will also need to be accounted for when predicting future upcoming workload requirements.

This paper proposes a new methodological approach to classify fielding positions. Specifically, the main aim of this study was to identify the demands of fielding by analysing three general positions within the game (catcher, ring fielder and boundary fielder) as well as the specialist wicketkeeping position, across three formats played (T20, One Day and Multi Day) by professional English county cricketers. Identifying the physical demands of fielding positions will help better inform the strength and conditioning coach in planning the athletes physical preparation not only by playing role, but by additionally taking into consideration the athletes typical fielding position.

2. Methods

2.1. Participants

Fourteen members of a professional team that played in the England and Wales Cricket Board (ECB) domestic competitions during the 2017 season volunteered to participate in the study. Participants (mean ± SD: age = 26 ± 6 years, height = 182.7 ± 6.6 cm, and body mass = 85.0 ± 6.0 kg) played in the following domestic competitions: The County Championship (Multi day), The Royal London One Day Cup (One day) and The NatWest T20 Blast (T20). Participants provided written informed consent before participation along with the ECB providing ethical approval for use of the data. The study also received local institutional research ethics approval.

2.2. Apparatus

Player movements were collected using Catapult optimeye S5 GPS (10 Hz) units. These units were randomly assigned to six players before the start of each days play. The GPS units were turned on 15 minutes before players took to the field to establish a GPS satellite lock in accordance with the manufacture's recommendations and prior studies (Petersen et al, 2009; Petersen et al, 2010; Reardon, Tobin, & Delahunt, 2015). Data was only collected during the fielding innings of each match. The GPS unit was placed in a protective sleeve integrated into a purpose-built vest; the position of the sleeve was between the shoulder blades overlying the player's upper thoracic spine. During multi day games (6 hours of play per day), units were charged during breaks between sessions. Throughout each match players wearing the GPS units were coded and had their positions recorded for every bowl delivered using SportsCode (Studiocode version 10, Sportstec, Australia). The assigned fielding roles were changed between balls and overs if a specific fielder changed their fielding position into a different category. Match footage was also recorded using a GoPro Hero Session (GoPro Inc. California, USA).

2.3. Task

Peak velocity assessment: Six days prior to the time motion analysis of the first competitive match the participants completed an assessment of maximum running velocity to establish the sprinting performance capability of players outside of a match environment. Each participant completed 3 x 40 m sprint efforts, with a 120s recovery between efforts, while wearing a Catapult optimeye S5 GPS (10 Hz) unit to calculate peak running velocity ($m.s^{-1}$).

Match analysis: Thirty-five specific fielding positions within the game of cricket were re-classified into three more generalised positions; catching, 30m inner ring and boundary (see Table 1). In addition, data was also collected on the specialised wicketkeeper position.

Specifically, at the start of the innings, fielders were placed into one of the three generalised categories above, dependent on their starting position on the field of play. This was documented before the first ball of the innings was bowled. Players were continuously monitored throughout the innings and their role was immediately altered if they changed their physical fielding position from one category to another between any ball. If there was no change between each ball, players would remain within their category until they crossed the threshold of another category and took their place within their next fielding position. For example, a 'Deep Mid-Wicket' (boundary) fielder might move into an 'Extra Cover' (inner-ring) position, or a 'Backward Point' (inner-ring) fielder might move into a 'Second-Slip' (stationary catching) position.

Table 1. Fielding positions classified into 3 generic positions

Catching	Inner Ring	Boundary
1st Slip	Mid on	Long on
2nd Slip	Mid wicket	Cow corner
3rd Slip	Square leg	Deep mid wicket
4th Slip	Backward square leg	Deep square leg
Gulley	Short fine leg	Deep backward square leg
Silly point	Fly slip	Deep fine leg
Silly mid off	Short third man	Third man
Silly mid on	Backward point	Deep backward point
Short Leg	Point	Deep point
Leg gully	Cover	Deep cover
Leg slip	Extra cover	Deep extra cover
	Mid off	Long off

2.4. Procedure

Participants were randomly assigned to wear GPS units during 14 of the competitive matches played across the three domestic competitions (4 x multi day, 6 x one day, and 4 x T20). Post-match, data stored on the OptimEye S5 GPS units were downloaded to OpenField 1.14.0 (Catapult Sports, Melbourne, Australia). Data were reviewed in both OpenField and Microsoft Excel (Microsoft Corporation, USA) and data were organised using Microsoft Excel. To increase the internal validity of the studies GPS data, video footage and SportCode data were aligned to identify the specific work done in each position. Given, the aim of the study was to investigate movement demands of general fielding positions, any bowling data recorded and any data collected while a player was off the field during play was not included.

2.5. Statistical Approach

The following movement speed bands on the openfield software were categorised as follows:

- Walking 0 - 7 $km.h^{-1}$ (0 - 1.94 $m.s^{-1}$)
- Jogging 7.01 - 15 $km.h^{-1}$ (1.95 – 4.16 $m.s^{-1}$)
- Striding 15.01 - 20 $km.h^{-1}$ (4.17 – 5.55 $m.s^{-1}$)
- High speed running 20.01 - 25 $km.h^{-1}$ (5.56 – 6.94 $m.s^{-1}$)
- Sprinting > 25 $km.h^{-1}$ (> 6.94 $m.s^{-1}$)

The data were downloaded to OpenField 1.14.0 software (Catapult Sports, Melbourne, Australia) and exported to Microsoft Excel where it was organized within the above movement speed bands for each data set. The positional analysis performed on SportsCode was then aligned with the data to identify the duration spent in each categorised fielding position and the work that was performed in that position was calculated. To identify the high intensity running demands of fielding positions, walking and jogging were considered as “low intensity running”; while striding, high speed running and sprinting were considered “high intensity running”. Distances are all reported in meters (m). Peak velocity ($m.s.^{1}$) was also recorded.

To facilitate a direct comparison of fielding positions, and additionally between the three match formats, positional movement data collected on each player was collated for each match and scaled to per hour of play. If a player had spent less than 20 minutes (represents ~25% of the fielding duration of the shortest game format) of the match in a fielding position the data was excluded as a data set for the analysis. Magnitude based inferences were also used to analyse the within position distance data between game formats (Batterham & Hopkins, 2006). The effect size statistic was generated to characterise the magnitude of difference between positions across the three formats of the game. The criteria for interpreting effect sizes were: <0.2 trivial, 0.2-0.6 small, 0.6-1.2 moderate, 1.2 – 2.0 large, and >2.0 very large (Hopkins, 2004).

3. Results

A player wearing a GPS unit needed to spend at least an accumulated 20 minutes in the same fielding position for the data to be included in the study as a single data set. From the 4 x T20 matches 9.0 hours of data were collected in the boundary position (n = 13), 7.6 hours on the ring fielder position (n = 11) and 3.2 hours on the wicketkeeper (n = 3) with no data collected on the position of catcher. From the 6 x One-day matches 29.4 hours of data were collected in the boundary position (n = 24), 57.8 hours on the ring fielder position (n = 31), 5.6 hours on the position of catcher (n = 9) and 8.4 hours on the wicketkeeper (n = 3). From the 4 x multi day matches 35.3 hours of data were collected in the boundary position (n = 14), 70.1 hours on the ring fielder position (n = 18), 38.8 hours on the position of catcher (n = 10) and 16.5 hours on the wicketkeeper (n = 2).

3.1. Fielding positional movement patterns

The relative distances covered by each fielding position for each game format is provided in Table 2. Extrapolating the data of a T20 innings (75 minutes) players fielding in the boundary position covered 4436 ± 769 m, the ring fielder position 3770 ± 804 m and the wicketkeeper 3325 ± 263 m. As noted above, no data was collected for the position of stationary catchers in T20 matches.

Extrapolating a One-day innings (3.5 h) players fielding in the boundary position covered 9221 ± 2593 m, the ring fielder position 8696 ± 1464 m, stationary catching positions 5754 ± 820 m and the wicketkeeper 7911 ± 500 m.

Meanwhile, extrapolating a full day of play of multi day cricket (3 x 2 h sessions) players fielding in the boundary position covered 12171 ± 1688 m, the ring fielder position 12659 ± 3533 m, catching positions 8185 ± 590 m and the wicketkeeper 10839 ± 1106 m.

3.2. High intensity running demands

The mean high intensity running distance covered per hour by players in each fielding position is illustrated in Figure 1. Extrapolated data for high intensity running during a T20 innings (75 minutes) revealed players fielding in the boundary position covered 628 ± 438 m, ring fielder position 170 ± 165 m and the wicketkeeper 97 ± 50 m.

During a One-day innings (3.5 h) players fielding on the boundary covered 930 ± 1085 m of high intensity running, while the ring fielder position 385 ± 342 m, catching position 227 ± 345 m and the wicketkeeper 83 ± 16 m performed a lot less high intensity running.

Table 2. Movement category distances by fielding position and game format

Format and position	Distance covered (meters / hour)					Total distance (m.h^{-1})
	Walking (0 - 7 kph^{-1})	Jogging (7.1 - 15 kph^{-1})	Striding (15.1 - 20 kph^{-1})	High Speed Running (20.1 - 25 kph^{-1})	Sprinting (>25 kph^{-1})	
Twenty20 (n = 4)						
Wicket keeper (n = 3)	1777 ± 46	805 ± 161	78 ± 40	-	-	2660 ± 210
Catcher (n = 0)						
Ring (n = 11)	2015 ± 413	866 ± 435	114 ± 114	17 ± 29	4 ± 8	3016 ± 643
Boundary (n = 13)	1788 ± 379	1259 ± 305	354 ± 263	95 ± 73	53 ± 62	3549 ± 615
One Day (n = 6)						
Wicket keeper (n = 3)	1507 ± 129[4]	729 ± 14[2]	24 ± 5[3]	-	-	2260 ± 143[4]
Catcher (n = 9)	1042 ± 236	537 ± 188	65 ± 99	-	-	1644 ± 234
Ring (n = 31)	1808 ± 332[1]	567 ± 234[2]	66 ± 39[1]	29 ± 65	15 ± 21[2]	2485 ± 418[2]
Boundary (n = 24)	1604 ± 333[1]	765 ± 396[3]	173 ± 231[2]	72 ± 67[1]	20 ± 30[2]	2635 ± 741[3]
Multi day (n = 4)						
Wicket keeper (n = 2)	1216 ± 130[d]†	586 ± 53[c]†	5 ± 1[d]†	-	-	1807 ± 184[d]†
Catcher (n = 13)	966 ± 114[*]	336 ± 125‡	40 ± 37[*]	13 ± 21	10 ± 8	1361 ± 93‡
Ring (n = 19)	1605 ± 429[b*]	406 ± 207[c#]	60 ± 36[b]	20 ± 15	19 ± 15[c]	1988 ± 608[c#]
Boundary (n = 17)	1322 ± 252[c#]	558 ± 205[d#]	112 ± 76[c*]	26 ± 17[c#]	10 ± 10[c*]	2018 ± 290[d#]

[1]Small, [2]moderate, [3]large and [4]very large magnitudes of difference within position between Twenty20 and One Day cricket. [a]Small, [b]moderate, [c]large and [d]very large magnitudes of difference within position between Twenty20 and Multi day cricket. [*]Small, [#]moderate, ‡large and †very large magnitudes of difference within position between One Day cricket and Multi day cricket.

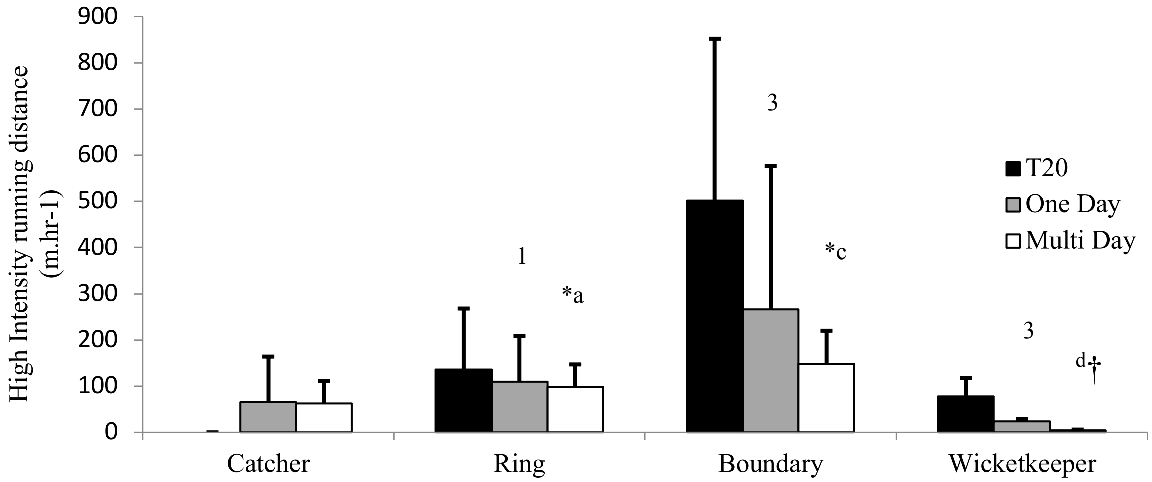
During a full day of play of multi day cricket (3 x 2 h sessions) players fielding in the boundary position covered 889 ± 435 m of high intensity running, in comparison the ring fielder position which covered 594 ± 286 m, and the positions of catcher 370 ± 291 m and the wicketkeeper 31 ± 8 m also performed considerably less.

3.3. Peak velocity

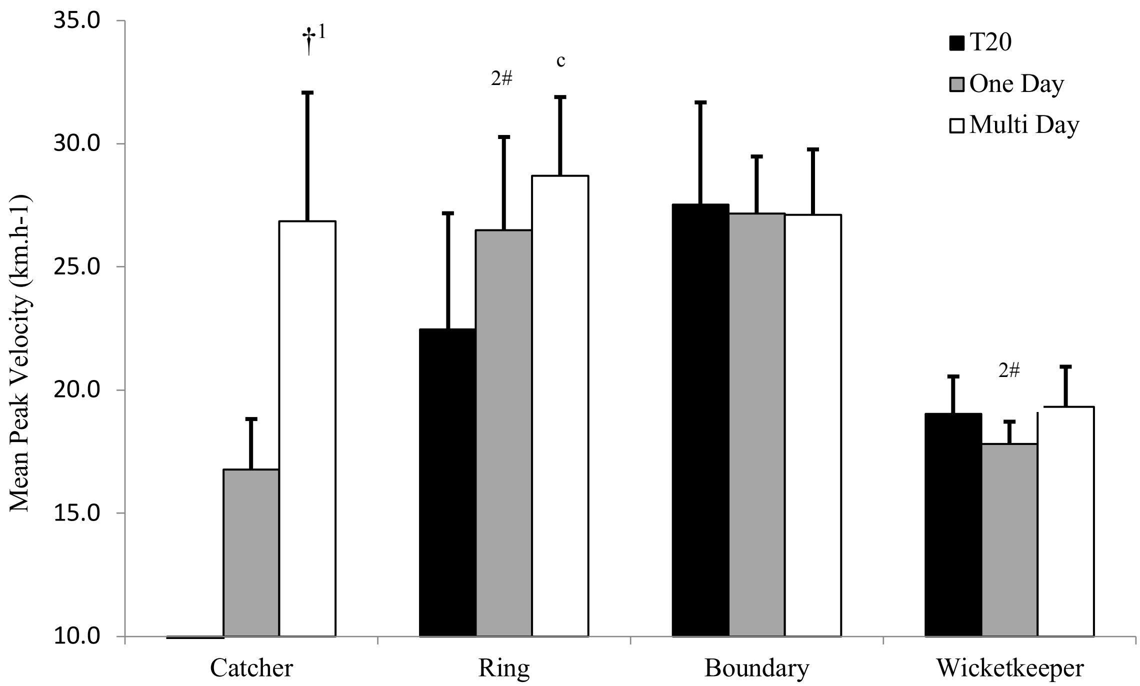
The mean peak velocity of participants prior to the season was 8.5 ± 0.5 m.s^{-1} (30.5 ± 1.8 km.h^{-1}). When this is compared to the fielding positional values displayed in Figure 2 it is evident that players do not reach their full sprint speed potential during matches. Specifically, during a T20 innings mean peak velocity recorded for the boundary position was 90% (7.64 ± 1.15 m.s^{-1}) of their previously recorded peak velocity. In comparison, the ring fielding position only attained a classified high speed running intensity which equated to 73% of the pre-season recorded peak velocity (6.24 ± 1.13 m. s^{-1}). While the wicketkeeper only managed to achieve the classified striding intensity which equated to 62% (5.29 ± 0.42 m.s^{-1}) of the pre-season recorded peak velocity.

Again, comparing to the pre-season peak velocity (8.5 ± 0.5 m.s^{-1}) during One-day innings the mean peak velocity recorded for the boundary position was 89% (7.55 ± 0.64 m.s^{-1}), the ring fielding position reached 87% (7.36 ± 1.05 m.s^{-1}) and the catching position peaked at a striding classified intensity of 55% (4.66 ± 0.57 m.s^{-1}). Similarly, the wicketkeeper only reaches a striding classified intensity of 58% (4.97 ± 0.25 m.s^{-1}) of the previously recorded peak velocity.

In the final comparisons with the pre-season sprinting values, during multi day innings mean peak velocity recorded in the boundary position was 89% (7.53 ± 0.71 m.s^{-1}) of the previously recorded peak velocity. While, the ring fielding position at 94% (8.02 ± 0.87 m.s^{-1}) reached a higher peak sprinting speed. The catching position at 89%, (7.56 ± 1.50 m.s^{-1}) was similar to the boundary position, whereas the wicketkeeper again could only manage to attain a striding classified intensity at 63% (5.37 ± 0.45 m.s^{-1}) of the pre-season recorded peak velocity.



[1]Small, [2]moderate, [3]large and [4]very large magnitudes of difference within position between Twenty20 and One Day cricket. [a]Small, [b]moderate, [c]large and [d]very large magnitudes of difference within position between Twenty20 and Multi day cricket. [*]Small, [#]moderate, ‡large and †very large magnitudes of difference within position between One Day cricket and Multi day cricket.
Figure 1. Mean (±sd) high intensity running distance covered per hour by fielding position



[2]moderate magnitude of difference within position between Twenty20 and One Day cricket.
[c]large magnitude of difference within position between Twenty20 and Multi day cricket.
[#]moderate and †very large magnitudes of difference within position between One Day cricket and Multi day cricket.

Figure 2. Mean (±sd) peak velocity by fielding position

4. Discussion

To our knowledge this is the first paper to address the limitation of role based reporting of Cricket GPS data. While there are a multitude of different cricket fielding positions from a logistical perspective with the given quantity of data these should be grouped together based on their similar skill demands. We therefore identified three main types of fielding position, but do recognise that with time and more sophisticated analyses using greater datasets it will be possible to define the actual specific demands of each individual position.

Roberts, Callaghan, & Jeffriess, (2014) found cricketers display similar sprint kinematics between two fielding generic positions (in-fielders versus out-fielders) and they hypothesised that this was due to players needing to field in either the infield or outfield depending on match situation. However, anecdotally, Strength and Conditioning coaches in the modern game have reported that most players specialise in fielding positions in the various game formats. While Strength and Conditioning Coaches could target developing all areas of general strength, speed and fitness in the off-season, knowing what each player will likely be exposed to or have to cope with will help identify 'worst case' scenarios, especially in regard to high speed and maximal sprinting distances. For these coaches who are responsible for the physical preparation and returning players back to play after injury, knowing the likely demands on their players based on their fielding position is very useful.

As we have previously outlined strength and conditioning coaches need to know the likely demands of fielding in different positions and these generic demands are summarised below.

4.1. Fielding on the boundary

There was a significant (~30%) increase in total distance per hour from multi day to one day (2028 to 2634 $m.hr^{-1}$) and ~35% increase in total distance (2634 to 3549 $m.hr^{-1}$) from one day to T20. High intensity running was significantly higher in One day when compared to Multi day, but there was no significant difference between One day and T20 demands. The mean peak velocity achieved during a match was not different between the formats.

4.2. Fielding in the ring

For fielders in the ring positions, despite small magnitudes of difference, there were no statistically significant differences in the amount of high intensity running per hour between the three match formats. When you consider that a day of multi day cricket lasts for 6 hours, players accumulate four times as much volume of high intensity running in multi day and twice as much volume in One day cricket compared to the shortest T20 match format.

Interestingly, the mean peak velocity for ring fielders was significantly higher in multi day compared to T20. Firstly, given the higher demands of getting boundaries in the shorter game formats there might be fewer opportunities to chase the ball. Additionally, it could be presumed that with more boundary fielders given the more defensive field placements of the T20 format this would offer less chances for ring fielders to chase a ball towards the boundary and hence offer less opportunities to reach their true peak velocity.

4.3. Fielding at a catching position

Total distance covered per hour was significantly higher in One day compared to the Multi day format, however there was no difference in high intensity running per hour between the formats. Mean peak velocity was significantly higher in the Multi day vs One day format. Again the difference in fielding strategies, i.e. using more attacking field placements in multi day compared to the One Day cricket format may help explain this difference with catchers having more chances to chase a ball in multi day cricket with the lack of a boundary fielder sweeping behind them. In the more explosive shorter game formats, players could be accumulating their total distance with more frequent but shorter distance running opportunities.

4.4. Wicketkeeper

There were significant increases in total distance per hour from Multi day to One day and from One day to the T20 formats. Likewise there was the same trend of significant increases in high intensity running per hour from Multi day to One day and from One day to T20 formats. The Wicketkeeper position is very specialised and while these running demands do not seem overly taxing, small fast reactions and quick change of direction movements including jumping and diving are likely to increase the overall loading of this position.

For One day and multi day matches, it is interesting to note the greater hourly total distances covered by generic fielders in the Australian game as reported by Petersen et al., (2011). The current positionally differentiated English fielding data has total hourly distances of ~1.6 – 2.6 $km{\cdot}h^{-1}$, whereas the Australian data reported ranges 3.0 – 3.6 $km{\cdot}h^{-1}$ (Petersen et al., 2011), speculatively this may be due to the differences in the respective ground sizes between the two countries. Alternatively, ground conditions, such as grass moisture and length could influence the number of opportunities to accumulate greater distances chasing balls in the outfield.

4.5. Conclusion

As demonstrated there are differences across specialist fielding positions therefore, there is a need to distinguish fielding demands from player roles to account for types of players that field in positions that break the stereotypical view of where certain players field. To emphasise this point some fast bowlers with good catching skills may be asked to field in close catching positions as opposed to the stereotypical boundary fielding role. Players also change between various types of fielding position within an innings so again we argue that it is more appropriate to present data for fielding position as opposed to player role.

Conflict of Interest

The authors declare no conflict of interests.

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